AM Receivers

Superheterodyne Receivers

Typical receiver circuits include:

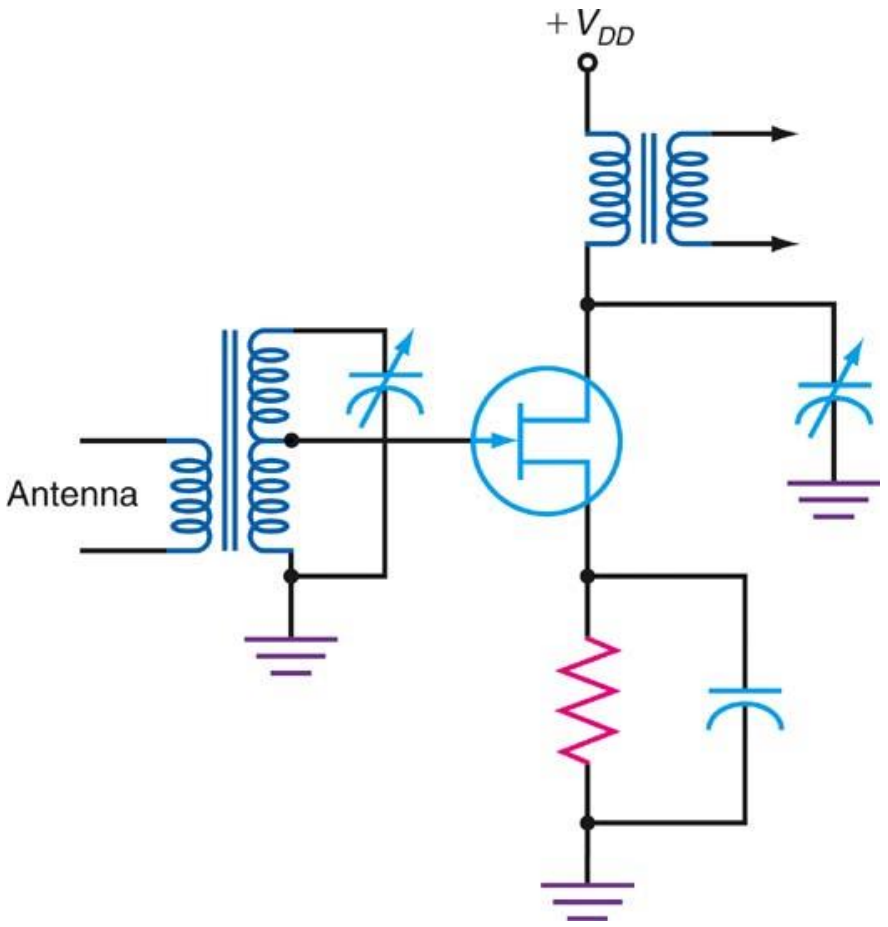
- RF amplifiers
- IF amplifiers
- Mixer

RF Amplifier

RF Input Amplifier

- The RF amplifier, also called a low-noise amplifier (LNA), processes the very weak input signals, increasing their amplitude prior to mixing.
- Low-noise components are used to ensure a sufficiently high S/N ratio.
- Selectivity should be such that it effectively eliminates images.
- The RF amplifier is typically a class A circuit that can be configured with bipolar or field-effect transistors.

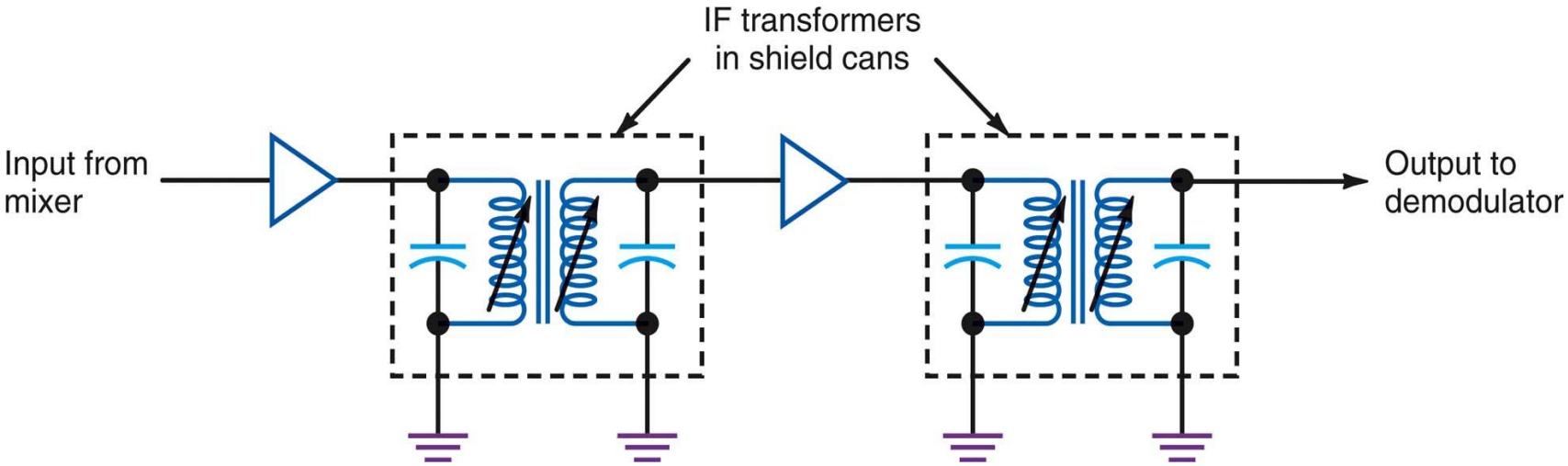
- Class A amplifier capable of providing gain in the 10- to 30-dB range.



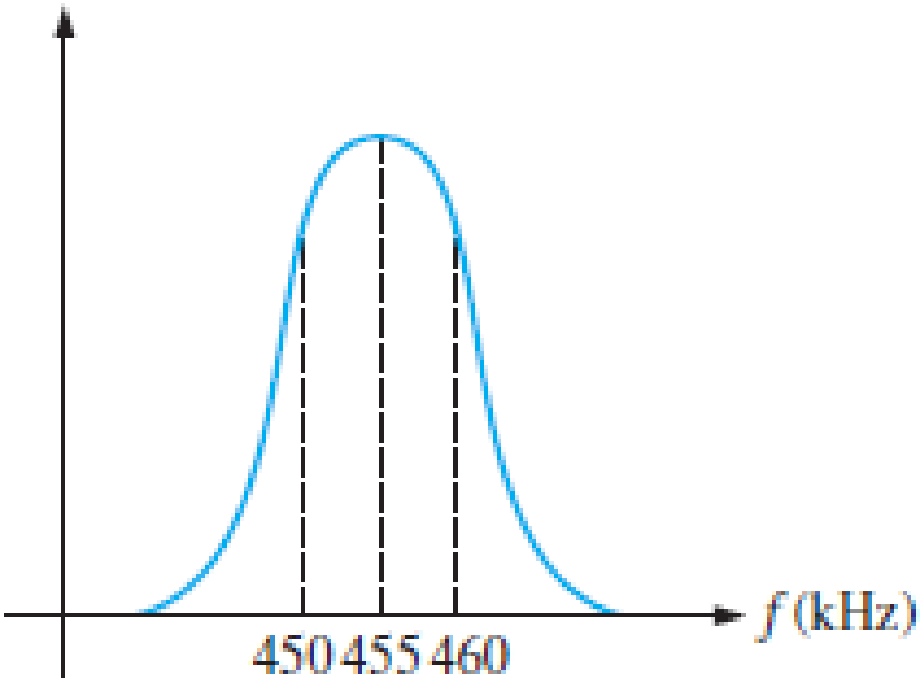
Class A RF amplifier

IF Amplifier

- The detailed circuitry of the IF amplifier may differ from one system to another, it always has a tuned (resonant) circuit on the input or on the output or on both.
- The IF amplifier is a frequency-selective circuit, it responds only to 455 kHz and any side frequencies lying in the 10 kHz band centered at 455 kHz. All of the frequencies out of the mixer are rejected except the 455 kHz IF, all lower-side frequencies down to 450 kHz, and all upper-side frequencies up to 460 kHz. This frequency spectrum is the audio modulated intermediate frequency

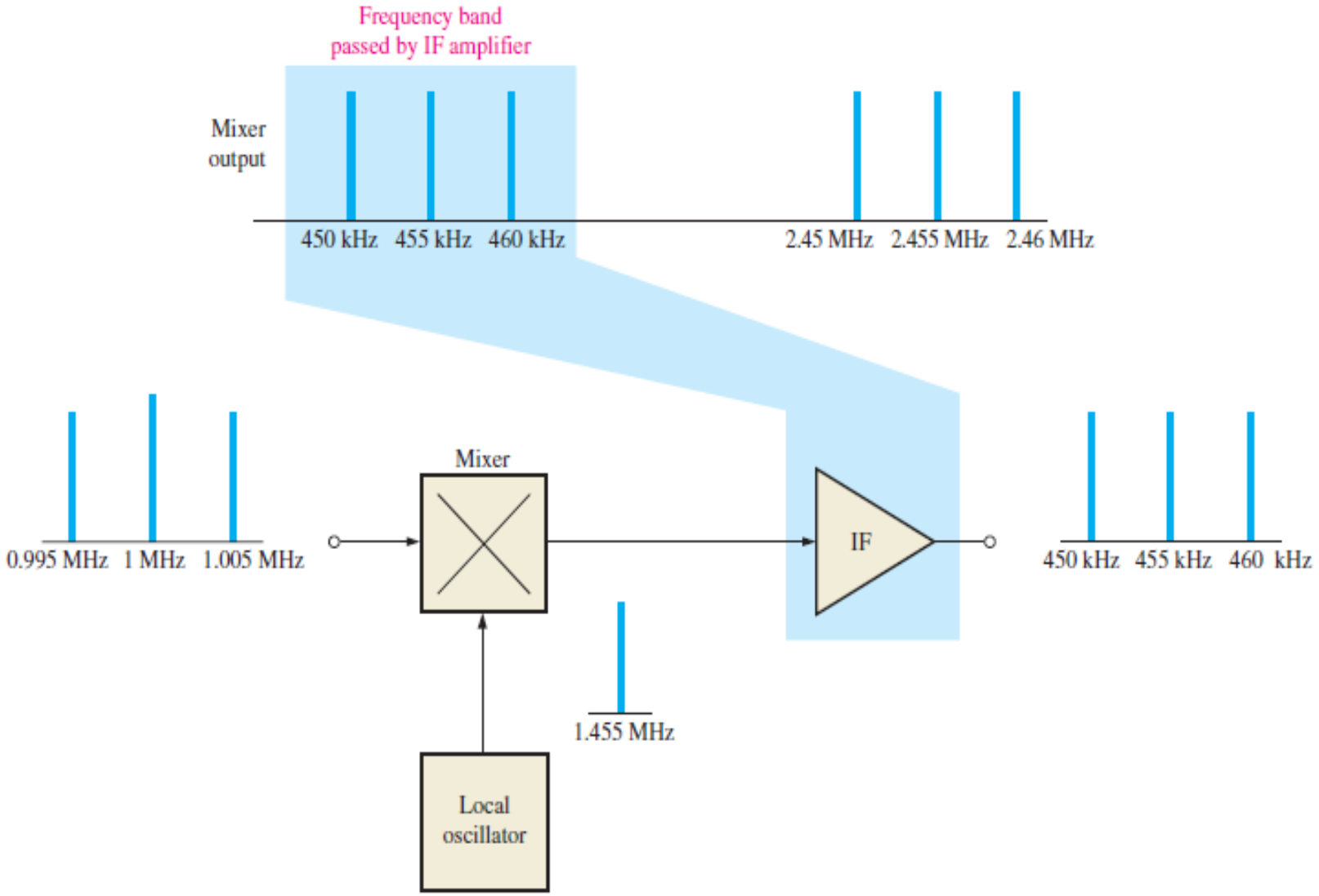


A two-stage IF amplifier using double-tuned transformer coupling for selectivity.



IF Frequency response curve

- Most of the gain and selectivity in a superheterodyne receiver are obtained in the IF amplifier.
- Usually two or more IF amplifiers are used to provide adequate receiver gain.



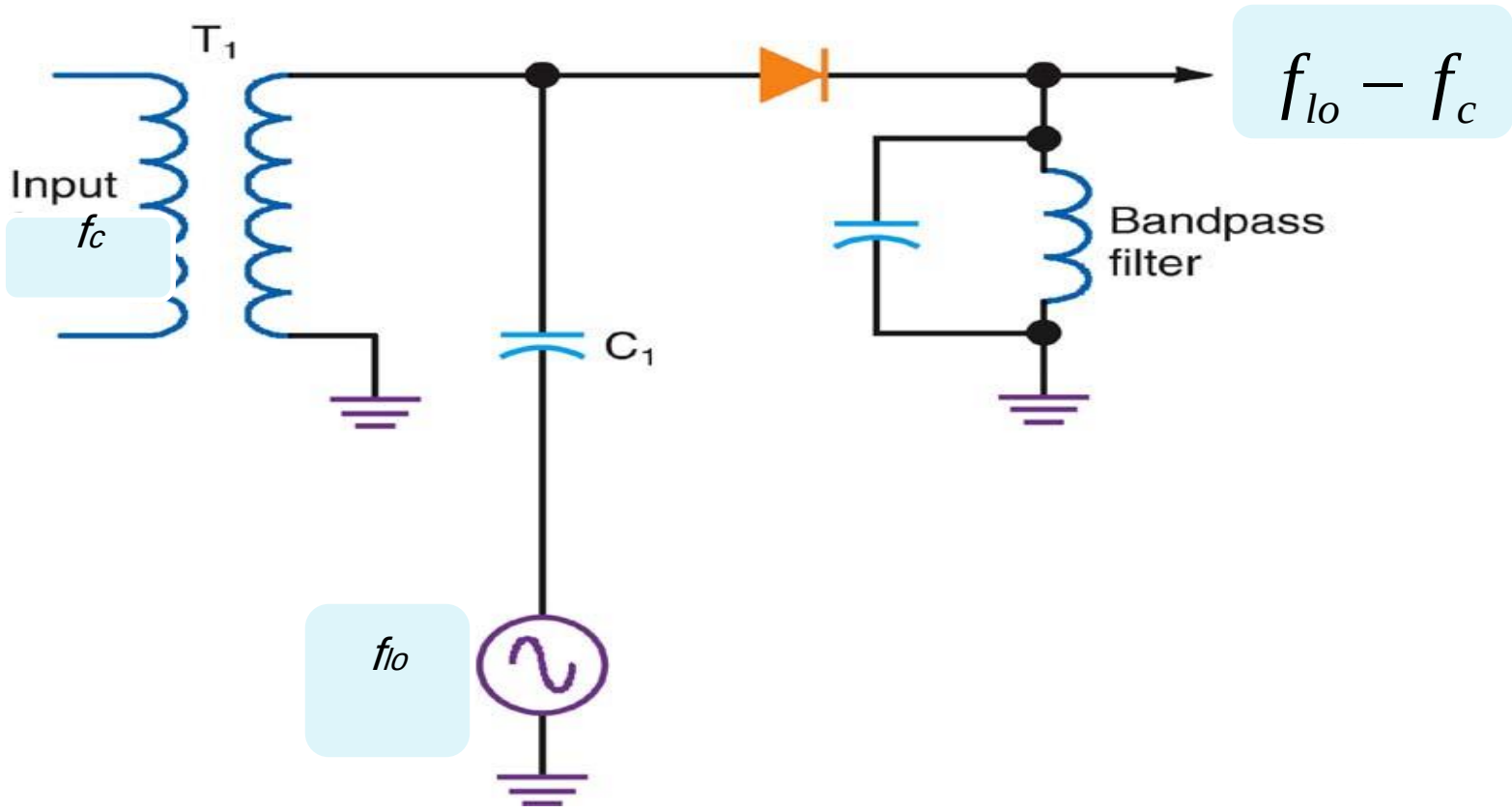
An illustration of the basic function of the IF amplifier in an AM receiver.

MIXER

- The primary characteristic of mixer circuits is nonlinearity.
- Any device or circuit whose output does not vary linearly with the input can be used as a mixer.
- One of the most widely used types of mixer is the simple diode modulator.

Diode Mixer

- The input signal is applied to the primary winding of the transformer.
- The signal is coupled to the secondary winding and applied to the diode mixer, and the local oscillator signal is coupled to the diode by way of a capacitor.
- The input and local oscillator signals are linearly added and applied to the diode, which produces the sum and difference frequencies.
- The output signals are developed across the tuned circuit which selects the difference frequency.



Circuit of diode mixer.

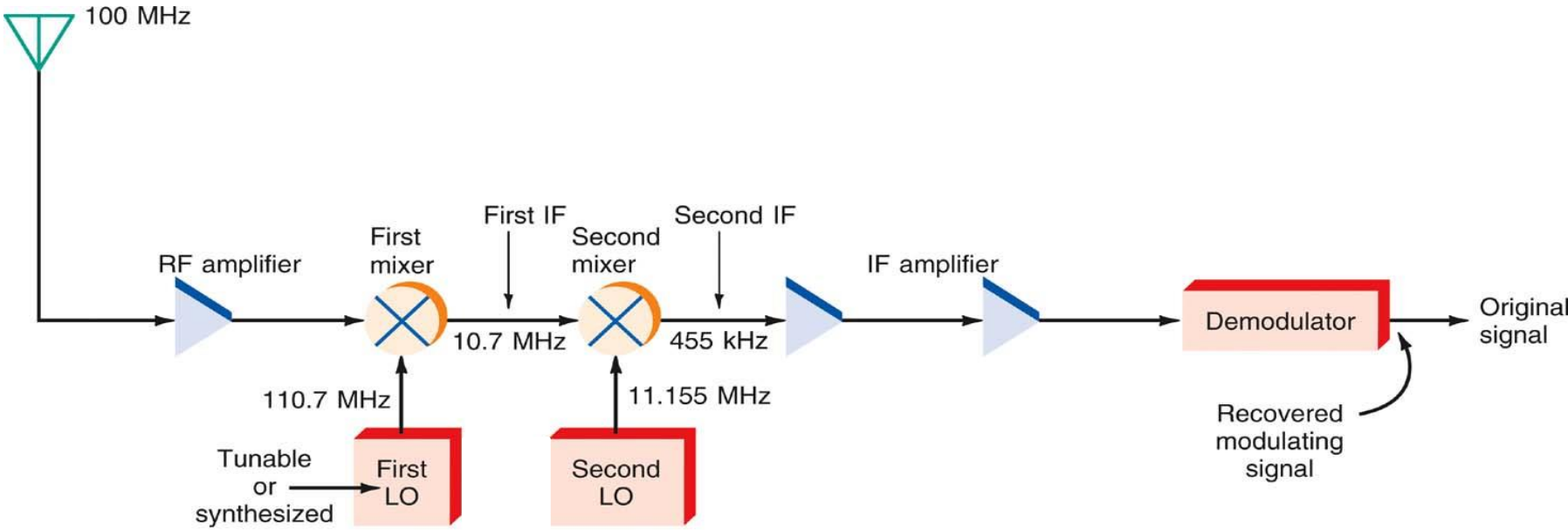
Image Problem

Solving the Image Problem

- To reduce image interference, high-*Q* tuned circuits should be used ahead of the mixer or RF amplifier.
- The IF is made as high as possible for effective elimination of the image problem, yet low enough to prevent design problems.
- In most receivers the IF varies in proportion to the frequencies that must be covered.

Dual-Conversion Receivers

- Another way to obtain selectivity while eliminating the image problem is to use a **dual-conversion superheterodyne receiver.**
- A typical receiver uses two mixers and local oscillators, so it has two IFs.
- The first mixer converts the incoming signal to a high intermediate frequency to eliminate the images.
- The second mixer converts that IF down to a much lower frequency, where good selectivity is easier to obtain.



A dual-conversion superheterodyne